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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* QING HU and BENJAMIN S. WILLIAMS

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Appeal 2009-002951  
Application 10/661,832  
Technology Center 2800

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Decided: November 24, 2009

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Before KENNETH W. HAIRSTON, ROBERT E. NAPPI, and THOMAS S.  
HAHN, *Administrative Patent Judges*.

NAPPI, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 6(b) of the rejection of claims 1 through 18.

We affirm.

#### INVENTION

The invention is directed to waveguides that can be used for confining lasing modes in the THz range. See paragraphs 0008-0010 of Appellants' Specification. Claim 1 is reproduced below:

1. A quantum cascade laser, comprising:  
an active region for generating lasing radiation in a frequency range of about 1 to about 10 Terahertz, and  
a waveguide formed of an upper metallic layer and a lower metallic layer, each layer being disposed on a surface of said active region so as to confine selected modes of said lasing radiation within said active region.

#### REFERENCES

Kneissl                      US 2004/0105471 A1                      Jun. 3, 2004

Karl Unterrainer et al. (Unterrainer), "Quantum Cascade Lasers with Double Metal-Semiconductor Waveguide Resonators," American Institute of Physics, Applied Physics Letters, vol. 80, no. 17, 3060-3062 (April 29, 2002).

Bin Xu et al. (Xu), "Electrically Pumped Tunable Terahertz Emitter Based on Intersubband Transition," American Institute of Physics, Applied Physics Letters, vol.71, no. 4, 440-442 (July 28, 1997).

## REJECTIONS AT ISSUE

The Examiner has rejected claims 1 through 6 and 8 through 18, under 35 U.S.C. § 103(a) as being unpatentable over Unterrainer in view of Xu. The Examiner's rejection is on pages 4 through 9<sup>1</sup> of the Answer.<sup>2</sup>

The Examiner has rejected claim 7 under 35 U.S.C. § 103(a) as being unpatentable over Unterrainer in view of Xu and Kneissl. The Examiner's rejection is on page 9 of the Answer.

## ISSUES

### *Claims 1 through 6, and 8*

Appellants argue on pages 4 through 7 of the Brief<sup>3</sup> that the Examiner's rejection of claims 1 through 6 and 8 is in error. Appellants argue on page 5 of the Brief that Unterrainer's teachings apply to a shorter wavelength than that recited in claim 1. Appellants also argue that Unterrainer and Xu teach away from using the double sided wave guides as recited in claim 1. Appellants argue that one skilled in art would not be motivated to combine the teachings of Xu and Unterrainer.

Thus, Appellants' contentions directed to the rejection of claim 1<sup>4</sup> present us with two issues:

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<sup>1</sup> We note that the Examiner relies upon different rationale to reject claims 1, 4, 6, 9 through 14, and 18 on page 7 through 9 of the Answer than on pages 4 through 6, but nonetheless rejects the claims over the combined teachings of Unterrainer and Xu. Further, we note that though claim 14 is not identified in the statement of the rejection on page 7 of the Answer, the rationale supporting the rejection on page 9 identifies claim 14 as rejected.

<sup>2</sup> Throughout the opinion we refer to the Answer mailed May 1, 2007.

<sup>3</sup> Throughout the opinion we refer to the Brief dated December 11, 2006.

<sup>4</sup> Appellants' arguments group claims 1 through 6, and 8. We select claim 1 as representative of the group.

1) Have Appellants shown that the Examiner erred in determining that the combined teachings of Unterrainer and Xu teach a laser waveguide that operates in a frequency range of 1 to 10 Terahertz with the waveguide formed with an upper and lower metallic layer (double sided metal waveguide) as recited in claim 1?

2) Have Appellants shown that the Examiner erred in concluding that one skilled in the art would combine the teachings of Unterrainer and Xu?

*Claims 15 and 17*

Appellants argue that the rejection of these claims is in error on page 8 of the Brief. Appellants' arguments assert that claim 15 recites that the quantum cascade laser operates in a frequency range of about 1THz to about 10THz, and has a waveguide formed with an upper and lower metallic layer. Thus, Appellants' arguments directed to these claims present us with the same issue as the first issue discussed above with respect to claim 1.

*Claims 1, 4, 6, and 9 through 14*

Appellants argue that the rejection of these claims is in error on pages 8 and 9 of the Brief. Appellants' arguments directed to these claims present us with the same issues discussed above with respect to claim 1.

*Claim 18*

Appellants argue on page 9 of the Brief, that the rejection of claim 18 is error. Appellants argue that claim 18 recites a Terahertz amplifier operating in the range between 1 THz to about 10 THz. Appellants argue that for the reasons discussed above with respect to claim 1, the combined teachings of Unterrainer and Xu do not teach or suggest a laser which

operates in a frequency range of 1 to 10 Terahertz and has a waveguide formed with an upper and lower metallic layer (double sided metal waveguide).

Thus, Appellants' arguments directed to claim 18 present us with the same issue as the first issue discussed above with respect to claim 1.

*Claim 7*

Appellants argue that the rejection of this claim is in error on pages 9 and 10 of the Brief. Appellants' arguments directed to these claims present us with the same issues discussed above with respect to claim 1.

We note that Appellants also argue that the additional teaching of Kneissl does not make up for the deficiencies in the rejection of claim 1. We do not reach the issues raised by this argument because as discussed *infra* our holding with respect to the rejection of claim 1 is dispositive of any issues raised by these arguments.

PRINCIPLES OF LAW

Appellant has the burden, when on appeal to the Board, to demonstrate error in the Examiner's position. *See In re Kahn*, 441 F.3d 977, 985-86 (Fed. Cir. 2006). The Examiner bears the initial burden of presenting a prima facie case of obviousness, and Appellant has the burden of presenting a rebuttal to the prima facie case. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992).

“A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from

the path that was taken by the applicant.” *Ricoh Co., Ltd. v. Quanta Computer, Inc.*, 550 F.3d 1325, 1332 (Fed. Cir. 2008) (quoting *Kahn*, 441 F.3d at 990). A reference does not teach away if it merely expresses a general preference for an alternative invention from amongst options available to the ordinarily skilled artisan, and the reference does not discredit or discourage investigation into the invention claimed. *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

On the issue of obviousness, the Supreme Court has stated that “the obviousness analysis cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 419 (2007). Further, the Court stated “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR*, 550 U.S. at 416.

#### FINDINGS OF FACT

1. Unterrainer teaches a Quantum Cascade (QC) laser with a double metal-semiconductor waveguide resonator for operating at wavelengths of 19, 21, and 24  $\mu\text{m}$ . Further, it is anticipated that the double metal-semiconductor, will work in wavelengths into the THz range. Abstract, p. 3060, and p. 3061, col. 2, para. 2.
2. Unterrainer teaches QC lasers with single sided waveguides, for which free carrier absorption contributes to losses and that a solution to the problem is to use a double metal semiconductor waveguide. P. 3060, col. 1, para. 3 to col. 2 para 1.

3. Unterrainer teaches that double metal waveguides and the single metal waveguide have almost equivalent performance, and that at increased wavelengths the double metal waveguide has better performance. P. 3061, col. 2, paras. 1 and 2.
4. Unterrainer also identifies that at low currents the light output of the double metal waveguide is higher than the single sided waveguide. P. 3062, col. 1, para. 1.
5. Unterrainer identifies that the double metal wave guide exhibits a slightly lower maximum temperature of operation as shown in Figure 2. However, this is attributed to poor heat sinking. An improved bonding process is suggested to improve the heat sinking and resolve the temperature related problems. P. 3061, col. 2, para. 2, p. 3062 col. 1, para. 1.
6. Xu teaches that the terahertz (THz) frequency range 1-10 THz or 30-300  $\mu\text{m}$  is underdeveloped and should be utilized. P. 440, para 1.

## ANALYSIS

### *Claims 1 through 6, and 8*

#### First issue:

Appellants have not persuaded us that the Examiner erred in finding that the combined teachings of Unterrainer and Xu teach a laser which operates in a frequency range of 1 to 10 Terahertz and has a waveguide formed with an upper and lower metallic layer. Claim 1 recites a laser which operates in a frequency range of 1 to 10 Terahertz and has a waveguide formed with an upper and lower metallic layer (double sided metal waveguide). The Examiner has found that Unterrainer teaches a laser



with a waveguide with an upper and lower metallic layer. Answer 4.

Further, the Examiner finds that Unterrainer's laser generates THz radiation, but not that the emitted radiation is in the range of 1 to 10 THz. Answer 4,

5. The Examiner finds that Xu teaches use of a laser which radiates in the 1 to 10 THz range and that the skilled artisan would combine the teachings.

Answer 5.

Appellants' arguments have not persuaded us that the Examiner erred in finding these facts. Appellants' arguments on page 5 of the Brief and pages 3 and 4 of the Reply Brief focus on the upper end of the wavelengths claimed by Appellants (300 microns), and that these wavelengths are more than an order of magnitude greater than the wavelengths Unterrainer teaches as being generated by the double sided metal waveguided laser. The Examiner provides a comprehensive response on pages 10 and 11 of the Answer, in which the Examiner finds that Unterrainer discusses operation in the 24  $\mu\text{m}$  range which is close to the lower end of Appellants claimed range (which equates to 30-300  $\mu\text{m}$ ). Further, the Examiner finds that Unterrainer teaches a double sided metal waveguide that has improved performance when used at longer waveguides. Answer 11. We find ample evidence to support these findings. Facts 3-4. Based upon these findings the Examiner concludes that the skilled artisan would be motivated to use the extended wavelengths and have a reasonable expectation of success when combining the double sided metal waveguide laser with Xu's teaching of using a laser at a longer wavelength. Answer 11. We concur with this conclusion by the Examiner as it is supported by ample evidence.

Appellants' arguments on pages 5 and 6 of the Brief and page 4 of the Reply Brief, also focus on the Experimental data depicted in Figure 2 of

Unterrainer, which shows that the double sided metal waveguide performs less efficiently. In response, the Examiner states on pages 11 and 12 of the Answer that while the data in the Figure shows that the single sided metal waveguide has slightly better characteristics, Figures 2 and 3 in Unterrainer demonstrate the closeness in performance between single sided metal waveguides and double sided waveguides. Answer 11. We concur with the Examiner's assessment and find that it is supported by the disclosure of Unterrainer which states "[t]he two waveguiding approaches have therefore almost equivalent performance." Unterrainer, p. 3061, col.2, para. 1. Further, as stated by the Examiner, on pages 12 and 13 of the Answer, even though Unterrainer in Figures 2 and 3 does identify a slight performance edge of the single sided metal waveguide, Unterrainer identifies a solution to improve the performance of the double sided metal waveguide to overcome the performance disadvantage. Further, Unterrainer teaches that the double sided metal waveguide has a performance advantage as the wavelengths get longer (i.e. closer to the region claimed). See Facts 1 and 3 through 5. Thus, the teachings of Unterrainer, while recognizing some limitations in the double sided metal waveguide, plainly expresses a preference for use of the double sided metal waveguide for longer wavelengths. Accordingly, Appellants' arguments have not persuaded us that the Examiner erred in determining that the combined teachings of Unterrainer and Xu teach or suggest a laser which operates in a frequency range of 1 to 10 Terahertz and has a waveguide formed with an upper and lower metallic layer (double sided metal waveguide) as recited in claim 1.

Second Issue

Appellants have not persuaded us that the Examiner erred in concluding that one skilled in the art would combine the teachings of Unterrainer and Xu. Appellants' arguments on page 6 of the Brief state that Xu "is not concerned with enhancing the efficiency of mode confinement." Appellants conclude that skilled artisans would have no motivation to consider ways to improve mode confinement and consider Unterrainer's teachings which are directed to a different wavelength. Further, Appellants assert that the skilled artisan would be dissuaded from utilizing the double sided metal waveguide of Unterrainer as discussed above. We are not persuaded of error.

In response to the Appellants' arguments the Examiner states that though Xu is not concerned with enhancing mode confinement, such a finding is not required to show that the skilled artisan would combine the references. We concur with the Examiner that obviousness can be shown if the combination of familiar elements yields predictable results. *KSR*, 550 U.S. at 416. The Examiner has found that given Unterrainer's teachings that the waveguide would provide improved performance at longer wavelengths, such as discussed in Xu, a skilled artisan would have a reasonable expectancy of success. We concur with the Examiner's conclusion, and, as discussed *supra*, we find that the record supports the Examiner's finding that Unterrainer teaches a double sided metal waveguide and encourages use of the waveguide at wavelengths approaching 1 THz (the lower end of the range taught by Xu and claimed by Appellants). Thus, we find ample evidence to support the Examiner's conclusion that using Unterrainer's

waveguide in the range taught by Xu would yield a reasonable expectancy of success (i.e. provide predictable results).

For the aforementioned reasons, the Appellants' arguments have not persuaded us of error in the Examiner's rejection of claim 1 and claims 2 through 6 and 8.

*Claims 15 and 17*

As discussed above Appellants' arguments directed to these claims present us with the same issue as the first issue discussed above with respect to claim 1. Claim 15, similar to claim 1, recites a laser with an active region operating in the 1 to 10 THz range, and that the active region is between two metal layers. As discussed *supra*, Appellants' arguments directed to claim 1 have not persuaded us of error in the Examiner's finding that the combination of Unterrainer and Xu teaches a laser which operates in a frequency range of 1 to 10 Terahertz and has a waveguide formed with an upper and lower metallic layer. Accordingly, we sustain the Examiner's rejection of claims 15 and 17 for the reasons discussed with respect to claim 1.

*Claims 1, 4, 6, 9 through 13, and 18*

As discussed above Appellants' arguments directed to these claims present us with same issues discussed above with respect to claim 1. Accordingly, we sustain the Examiner's rejection of claims 1, 4, 6, 9 through 13, and 18 for the reasons discussed above with respect to claim 1.

*Claim 18*

As discussed above Appellants' arguments directed to claim 18 present us with the same issue as the first issue discussed above with respect to claim 1. As discussed *supra*, Appellants' arguments directed to claim 1 have not persuaded us of error in the Examiner's finding that the combination of Unterrainer and Xu teaches or suggest a laser which operates in a frequency range of 1 to 10 Terahertz and has a waveguide formed with an upper and lower metallic layer. Accordingly, we sustain the Examiner's rejection of claim 18 for the reasons discussed with respect to claim 1.

*Claim 7*

As discussed above, Appellants' arguments directed to this claim present us with the same issues discussed above with respect to claim 1. As also discussed above we are not persuaded by Appellants' arguments directed to claim 1. We note that Appellants' additional argument on page 10 of the Brief that the additional teaching of Kneissl does not make up for the deficiencies in the rejection of claim 1 is not persuasive as we find no deficiencies in the rejection of claim 1. Accordingly, we sustain the Examiner's rejection of claim 7.

CONCLUSION

Appellants have not persuaded us of error in the Examiner's rejections of claims 1 through 18.

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Application 10/661,832

ORDER

The decision of the Examiner to reject claims 1 through 18 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

ELD

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